(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 357 270 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: 89308133.1

(22) Date of filing: 10.08.89

(51) Int. Cl.5: A61F 2/34 , //A61F2/46, A61B17/16

(30) Priority: 17.08.88 GB 8819587

(43) Date of publication of application: 07.03.90 Bulletin 90/10

(84) Designated Contracting States: DE FR GB IT NL SE

(71) Applicant: MINNESOTA MINING AND MANUFACTURING COMPANY
3M Center
Saint Paul, Minnesota 50101(US)

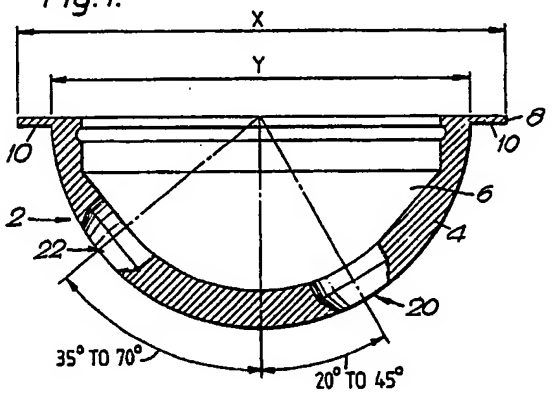
(72) Inventor: Shelley, Philip
2 St.John's Rd, Laughton Enlemouthern
Dinnington S31 7YL(GB)

(74) Representative: Bowman, Paul Alan et al
LLOYD WISE, TREGEAR & CO. Norman House 105-109 Strand
London WC2R OAE(GB)

(54) Rim-bearing acetabular component of hip joint prosthesis.

(57) An acetabular implant for a hip joint prosthesis comprising a metal cup shell (2) adapted for securing in the acetabulum of a patient, the metal cup shell (2) having a bore (6) into which a liner may be inserted to provide a spherical bearing surface for the ball portion of the hip joint, characterised in that the metal cup shell (2) comprises three apertures (20, 22, 24) positioned for insertion of screws (26,28) into the ilium, ischium and pubic ramus of the patient and a continuous circumferential flange (8) around the opening of the bore (6), the flange (8) having an outside diameter (X) which is at least 10% greater than the outside diameter (Y) of the remainder of the metal cup shell (2) at its widest point, the circumferential flange (8) providing a bearing surface (10) for contacting the rim (12) of the acetabulum of the patient when the metal cup shell (2) is fitted.

Fig.1.



EP 0 357 270 A1

RIM-BEARING ACETABULAR COMPONENT OF HIP JOINT PROSTHESIS

This invention relates to a hip joint prosthesis and in particular to the acetabular component of a hip joint prosthesis.

Prosthesis for the replacement of hip joints are well known. Originally, only the ball-end on the head of the femur could be replaced but it has since proved possible to replace either part of the hip joint i.e. the acetabular socket of the joint or the ball-end on the femur.

Known acetabular cup implants, which form the socket portion of an artificial hip joint, comprise a metal cup shell, which is secured within a cavity in the pelvic bone of a patient, and an inner liner of plastics material which provides a spherical bearing surface for receiving the ball portion of the joint. The metal cup shell may be provided with an external thread to facilitate anchorage to the pelvic bone or may be secured by other means such as cement or screws.

Most current designs of metal cup shells can be grouped into two basic profiles - frusto-conical and hemispherical since these shapes may be conveniently fabricated by rotating reamers. In all cases the designs rely upon the floor and internal walls of the acetabulum for anchorage and to transmit the forces to which the joint is subjected.

There are several designs of acetabular cup implants which comprises a continuous or discontinuous circumferential flange around the opening of the cup implant. U.S. Patent No. 4563778 discloses an acetabular cup assembly having a circumferential flange, a cup assembly being adapted for securing with bone cement. U.S. Patent No. 3982281 discloses an acetabular cup assembly possessing a circumferential flange which cup assembly is inserted into the acetabulum so that there is initially clearance between the flange and the bone structure to allow settling movement in the device before the flange contacts the bone. U.S. Patent No. 4180873 discloses a frusto-conical cup shell possessing a circumferential flange which is force fitted into a prepared bone void of the acetabulum.

It is an anatomical fact that the thickest and strongest section of the pelvis in the acetabular region is the rim of the acetabulum. However, this rim presents an uneven and irregular margin which has precluded its use for load bearing in a hip joint prosthesis. It has now been found that by smoothing the rim of the acetabulum and providing a metal cup shell with a flange which bears on the machined surface the potential load bearing capacity of the rim of the acetabulum can be effectively utilized in addition to the internal surfaces of the acetabulum.

Therefore according to one aspect of the present invention there is provided an acetabular implant for a hip joint prosthesis comprising a metal cup shell adapted for securing in the acetabulum of a patient, the metal cup shell having a bore into which a liner may be inserted to provide a spherical bearing surface for the ball portion of the hip joint, characterised in that the metal cup shell comprises a circumferential flange around the opening of the bore, the flange having an outside diameter which is at least 10% greater than the outside diameter of the remainder of the metal cup shell at its widest point, the circumferential flange providing a bearing surface for contacting the rim of the acetabulum of the patient when the metal cup shell is fitted.

The circumferential flange of the metal cup shell of the invention provides an effective means of transmitting forces in the hip joint to the pelvic bone thereby reducing stresses in other parts of the joint. The circumferential flange generally has an outside diameter which is from 10 to 40% greater than that of the remainder of the metal cup shell, preferably 20 to 40% greater.

The bearing surface of the circumferential flange is preferably planar and at a right angle to the longitudinal axis of the bore although the plane of the bearing surface may be slightly inclined with respect to the longitudinal axis of the bore. The bearing surface may also be frusto-conical or curved. The flange is preferably continuous to provide maximum transmission of forces to the pelvic bone but some discontinuities are permissible e.g. slits or notches.

The metal cup shell is secured to the acetabulum by conventional techniques e.g. cement, screw thread on the outer surface or screws passing through the shell. In order to maximise the diameter and length of the screws (and the anchorage of the metal cup shell) the arrangement is to use three screws projecting into the ilium, ischium and pubic ramus. The metal cup shell has three apertures for accepting such screws drilled at the correct angles for optimum positioning and the screws may readily be inserted through a guide to ensure accurate positioning. The following configuration of apertures and positioning of the screws is particularly useful:

when viewed in plan the angle formed between a line passing through the centre of the aperture for the superior screw and the centre of the bore and a line passing through the centre of an aperture for an inferior screw and the centre of the bore is in the range 100 to 160°; preferably the apertures are positioned at 0°, 130° and 230°;

in the side view the angle formed between the longitudinal axis of the bore and the longitudinal axis of the aperture for the superior screw and the longitudinal axis of the bore is from 20 to 45° preferably 30°, and the angle formed between the longitudinal axis of an aperture for an inferior screw and the longitudinal axis of the bore is from 35 to 75°, preferably 50°.

The invention will now be described with reference to the accompanying drawings in which:

- Figure 1 represents a cross-section through a metal shell cup in accordance with the invention,
- Figure 2 represents a plan view of a shell cup in accordance with the invention,
- Figure 3 represents a section through an acetabulum showing a metal shell cup anchored to the pelvic bone.
- Figures 4 and 5 represent a reaming tool and blade for reaming the rim of the acetabulum and
- Figure 6 represents an alignment guide for inserting screws through the metal cup shell into the pelvic bone.

Referring to Figures 1 to 3 the metal cup shell 2 comprises a substantially hemispherical body 4 defining a bore 6. The shell includes a circumferential flange 8 having a diameter 'X' which is from 10 to 40% greater than the diameter 'Y', the widest outside diameter of the remainder of the metal cup shell. The flange 8 has a bearing surface 10 which bears against the required surface 12 of the rim of the acetabulum when the cup shell is fitted (see Figure 3). The cup shell is preferably fabricated from titanium or a titanium alloy including aluminium or vanadium.

Figures 1 to 3 also illustrate the configuration of apertures and screws for optimum fixing of the metal cup shell within the pelvic bone 14 (Figure 3). The centres of apertures 22 and 24 for the inferior screws are arranged as shown in Figure 2 forming angles of from 100 to 160° on either side of the aperture 20 for the superior screw. When viewed in cross-section as in Figure 1 the longitudinal axis of the aperture for the superior screw forms an angle of from 20 to 45° with the longitudinal axis of the bore and those for the inferior screws form an angle of from 35 to 70°. The screws 26, 28 may readily be inserted through the apertures and in correct alignment using the guide shown in Figure 6. The guide comprises an insert 60 which is positioned within the metal cup shell and three holes having diameters comparable to the outside diameter of the screws, which bones are aligned to the desired positioning for the screws. The holes of the guide are aligned with the apertures in the metal cup shell and the screws inserted in the respective holes in the guide and driven into the pelvic bone to securely anchor the metal cup shell.

In order to ensure good fitting of the metal cup shell the acetabulum must be reamed in the conventional manner and the rim of the acetabulum must be shaved or reamed to provide a mating surface for the bearing surface of the flange. Figure 4 illustrates a reaming tool comprising a blade 40 for shaving the rim of the acetabulum. The end 42 of the tool comprises a centralising body which is inserted in the acetabulum and the instrument rotated so that the blade 40 shaves the rim of the acetabulum to provide a smooth surface.

An example of a suitable blade is shown in Figure 5 having a cutting edge 50 and a radius R which is selected to be at least one half the diameter of the flange.

The metal cup shell of the invention may be used with conventional plastics and/or ceramic inserts to provide the spherical bearing surface for the ball of the joint. The metal cup shell may also conform to the configuration of that disclosed in our corresponding British Patent Application No. 8819587.0 which describes an acetabular implant comprising a metal cup shell adapted for securing to the pelvic bone of a patient and a plastics insert for receiving the ball portion of a hip joint, the bore of the metal cup shell and outer surface of the plastics insert being dimensioned to allow an interference fit of the plastics insert within the bore at the body temperature of the patient in which the surface of the metal shell defining the bore is provided with one or more apertures into which the plastics material of the insert may flow when the insert is fitted to provide a mechanical interlock between the insert and cup shell thereby securing the insert against rotational and distraction forces relative to the metal cup shell. The apertures may conveniently take the form of a concentric groove near the opening of the bore and one or more radial grooves.

Claims

1. An acetabular implant for a hip joint prosthesis comprising a metal cup shell (2) adapted for securing in the acetabulum of a patient, the metal cup shell having a bore (6) into which a liner may be inserted to provide a spherical bearing surface for the ball portion of the hip joint, characterised in that the metal cup shell comprises three apertures (20, 22, 24) positioned for insertion of screws into the ilium, ischium and pubic ramus of the patient and a continuous circumferential flange (8) around the opening of the bore, the flange having an outside diameter which is at least 10% greater than the outside diameter of the remainder of the metal cup shell at its widest point, the circumferential

flange providing a bearing surface (10) for contacting the rim of the acetabulum of the patient when the metal cup shell is fitted.

2. An acetabular implant as claimed in claim 1 in which the outside diameter of the flange (8) is from 10 to 40% greater than that of the remainder of the metal cup shell.

3. An acetabular implant as claimed in claim 2 in which the outside diameter of the flange (8) is from 20 to 40% greater than that of the remainder of the metal cup shell.

4. An acetabular implant as claimed in any preceding claim in which the bearing surface (10) of the flange is planar and at substantially a right angle to the longitudinal axis of the bore.

5. An acetabular implant as claimed in any one of claims 1 to 3 in which the bearing surface (10) of the flange is frusto-conical.

6. An acetabular implant as claimed in any preceding claim in which the three apertures are arranged such that:

- when viewed in plan the angle formed between a line passing through the centre of the aperture for the superior screw and the centre of the bore and a line passing through the centre of an aperture for an inferior screw and the centre of the bore is in the range 100 to 160°; and
- in the side view, the angle formed between the axis of the longitudinal axis of the aperture for the superior screw and the longitudinal axis of the bore is from 20 to 45° and the angle formed between the longitudinal axis of an aperture for an inferior screw and the longitudinal axis of the bore is from 35 to 75°.

7. An acetabular implant as claimed in claim 6 in which the three apertures are arranged such that:

- when viewed in plan the centres of the apertures are positioned at 0°, 130° and 230°, the aperture for the superior screw being at 0°, and
- in the side view said angle for the aperture of the superior screw is 30° and said angle for the apertures of the inferior screws is 50°.

Fig.1.

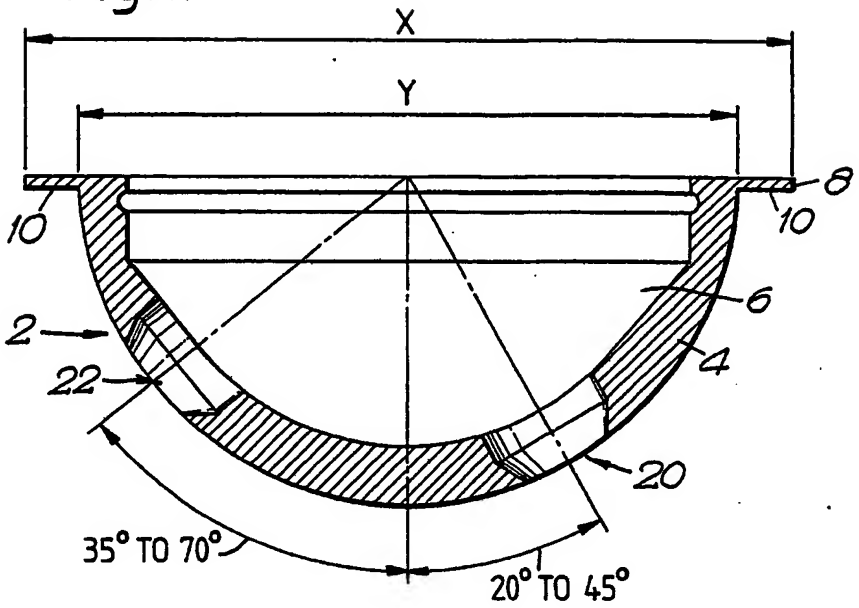

X
Y
8
10
10
6
2
4
22
20
35° TO 70°
20° TO 45°

Fig.2.

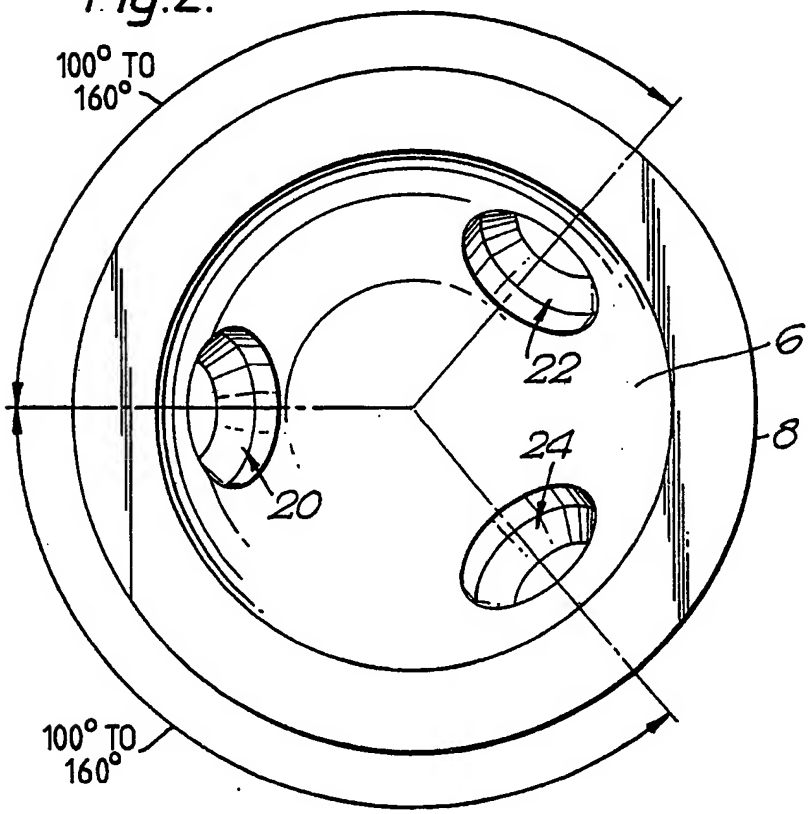

100° TO 160°
22
6
8
24
20
100° TO 160°

Fig.3.

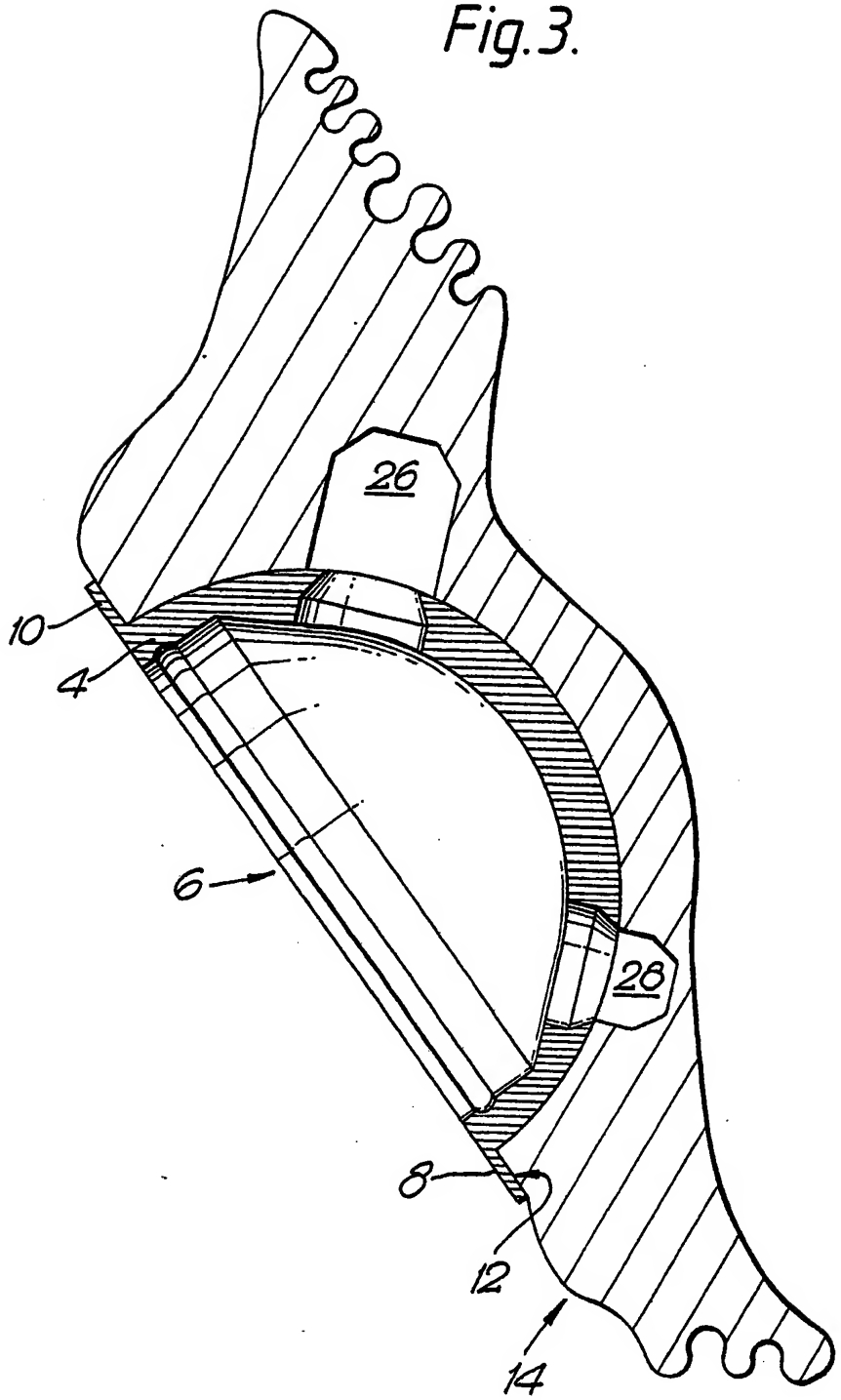


Fig.4.

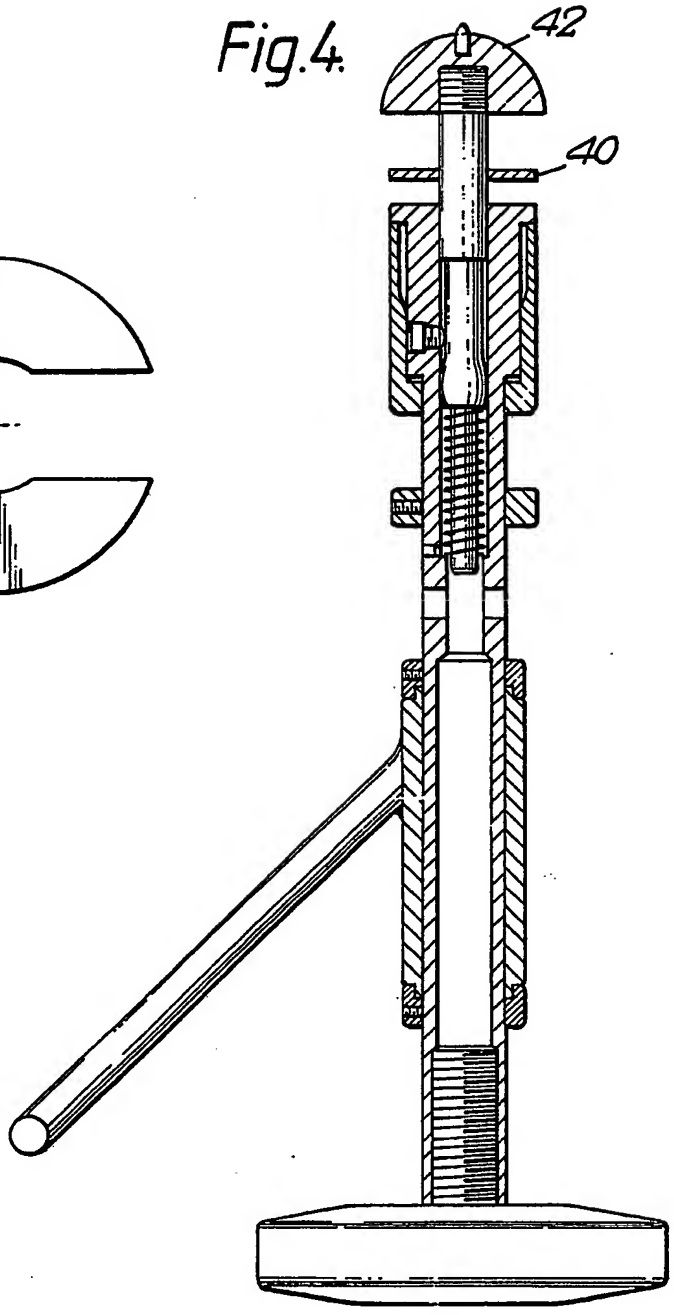


Fig.5.

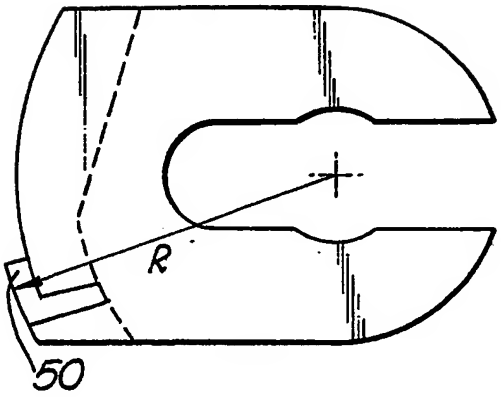
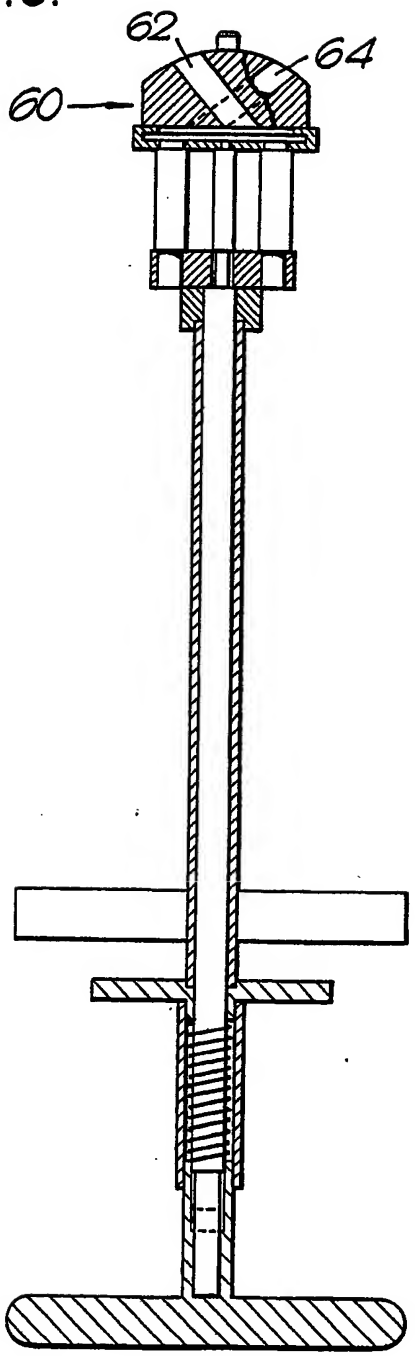


Fig.6.



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 89 30 8133

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
Y	DE-A-3 310 944 (ERLER) * Page 6, lines 24,25; page 10, lines 20-23; abstract; figures 1-3,8-10 *	1,4,6	A 61 F 2/34 // A 61 F 2/46 A 61 B 17/16
A		7	
Y,D	US-A-4 180 873 (FIXEL) * Column 1, lines 49-61; column 2, lines 15-18; figure *	1,4,6	
A		2	
A	EP-A-0 022 308 (NELSON) * Page 10, lines 5-10; figures 4,6 *	1	
Y	CH-A- 663 893 (SULZER) * page 2, column 2, lines 38,39; page 3, column 1,line 9 - column 2, line 10; figures *	1-3,5	
A		6,7	
Y	EP-A-0 118 194 (THACKRAY) * Page 3, lines 13-15; claim 11; figures *	1-3,5	TECHNICAL FIELDS SEARCHED (Int. Cl.5)
A	DE-U-8 701 242 (ORTHOPLANT) * Page 6, lines 10-14; figures *	1,2,5	A 61 F
A,D	EP-A-0 120 595 (3 M)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23-11-1989	KLEIN C.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P0401)